

**CLAIMS:**

1. An evanescent wave cavity-based optical sensor, the sensor comprising:
  - an optical cavity formed by a pair of highly reflective surfaces such that light within said cavity makes a plurality of passes between said surfaces, an optical path between said surfaces including a reflection from a totally internally reflecting (TIR) surface, said reflection from said TIR surface generating an evanescent wave to provide a sensing function;
  - a light source to inject light into said cavity; and
  - a detector to detect a light level within said cavity; and
  - wherein said TIR surface is provided with an electrically conducting material over at least part of said TIR surface such that said evanescent wave excites a plasmon within said material;
  - whereby a change in absorption of said evanescent wave due to a change in said plasmon excitation is detectable using said detector to provide said sensing function.
2. An evanescent wave cavity ring-down sensor comprising:
  - a ring-down optical cavity including an attenuated total-internal-reflection based sensing device for sensing a substance modifying a ring-down characteristic of the cavity;
  - a continuous wave light source for exciting said cavity; and
  - a detector for monitoring said ring-down characteristic; and
  - wherein said sensing device is provided with an electrically conducting material adjacent a total internal reflection (TIR) interface of said device such that an evanescent wave at said interface generates a plasmon excitation within said material, said plasmon excitation being modifiable by said sensed substance to modify said cavity ring-down characteristic.
3. A sensor as claimed in claim 1 or 2 wherein said optical cavity comprises a fibre optic sensor configured to provide an evanescent field from light guided within the fibre to said conducting material to excite said plasmon for said sensing.
4. A sensor as claimed in claim 1, 2 or 3 wherein said conducting material comprises one or more of islands of conducting material, particles and aggregates; and wherein said plasmon comprises a localised or particle plasmon.
5. A sensor as claimed in claim 1, 2, 3 or 4 wherein said electrical conducting material comprises metallic regions having an average size of less than 50  $\mu\text{m}$ .
6. A sensor as claimed in claim 5 wherein said regions comprise irregular islands.
7. A sensor as claimed in claim 1, 2, 3 or 4 wherein said electrical conducting material comprises metallic particles having an average size of less than 50 nm.

8. A sensor as claimed in any one of claims 4 to 7 wherein said light source is configured to provide light at two wavelengths straddling said plasmon excitation.
9. A sensor as claimed in claim 1, 2 or 3 wherein said conducting material comprises a substantially continuous film and wherein said plasmon comprises a surface plasmon.
10. A sensor as claimed in any preceding claim wherein said conducting material is bound to said TIR surface/interface by a molecular link.
11. A sensor as claimed in any preceding claim wherein said conducting material comprises gold.
12. A sensor as claimed in any preceding claim further comprising a functionalising material associated with said conducting material to provide a selective response for said evanescent wave surface plasmon sensing.
13. A sensing device as recited in any one of claims 1 to 12.
14. A sensor for a cavity of an evanescent-wave cavity ring down device, the sensor comprising a fibre optic cable having a core configured to guide light down the fibre surrounded by an outer cladding of lower refractive index than the core, wherein a sensing portion of the fibre optic cable is configured have a reduced thickness cladding provided with an electrically conducting material such that an evanescent wave from said guided light is able to excite a plasmon within said material.
15. An optical cavity-based sensing device comprising:  
an optical cavity absorption sensor comprising an optical cavity formed by a pair of reflecting surfaces;  
a light source for providing light to couple into said cavity; and  
a light detector for detecting a level of light escaping from said cavity;  
wherein said optical cavity includes a plasmon-based sensing device, said device comprising a layer of conducting material with a functionalised surface.
16. A cavity ring-down sensor comprising:  
a ring-down optical cavity for sensing a substance modifying a ring-down characteristic of the cavity;  
a light source for exciting said cavity; and  
a detector for monitoring said ring-down characteristic; and  
wherein said optical cavity includes surface a plasmon-based sensing device, said sensing device comprising a layer of conducting material with a functionalised surface.
17. A sensor as claimed in claim 15 or 16 wherein said functionalised surface is configured to provide a selective sensing response for the sensor.
18. A sensor as claimed in claim 15, 16 or 17 wherein said functionalised surface comprises a protein.

19. A sensor as claimed in claim 15, 16 or 17 wherein said functionalised surface comprises a monoclonal or polyclonal antibody.
20. A sensor as claimed in claim 15, 16 or 17 wherein said functionalised surface comprises a DNA and/or RNA.
21. A method of refreshing a plasmon-based sensing device, the device comprising a layer of conducting material optionally with a functionalised surface, the method comprising applying an electrical charge or potential to the conducting material to refresh the device.
22. A method as claimed in claim 21 further comprising switching said electrical charge or potential between a first, sensing state and a second, refreshing state.
23. A method as claimed in claim 22 wherein said switching comprises reversing said electrical charge or potential.
24. A plasmon-based sensing device comprising a sensing surface bearing a layer of conducting material, and including a sensing surface refresh system.
25. A plasmon-based sensing device as claimed in claim 24 wherein said layer of conducting material has a functionalised surface.
26. A plasmon-based sensing device as claimed in claim 24 or 25 wherein said sensing surface refresh system comprises a system for applying an electrical charge or potential to the conducting material to refresh the device.